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COVER STORY
BY MICHAEL FISCHER

Hard-Disk DRIVES Made Easy

You've finally decided to add a hard-disk drive to your Apple, but you don't know which to choose? To help you out, we review six major brands, and we guide you through the selection process.

Hard-disk drives don't excite you? Once you've experienced the significant increase in computing power and speed they provide, together with the ease of always having the right disk available, you'll probably change your mind. Owning a hard-disk drive may even begin to seem imperative if you have an Apple IIGS. Sophisticated GS programs can take a long time to load, and they require heavy disk access, both processes that a hard-disk drive can speed dramatically.

After you decide to add a hard-disk drive to your Apple II computer, you face many different choices, since many hard-disk drives are available for the Apple II family. Some work only with certain machines. Others can handle only certain operating systems. This article will help you through the selection process.

My viewpoint is that of a user. I discuss hard-disk drives in terms that should make sense to everyone. You won't find discussions of transfer rate, average latency, or skewing factor. These fairly technical measurements are of marginal assistance in selecting a drive. The selection process, particularly for Apple II drives, is much simpler.

The two main reasons for getting a hard-disk drive are convenience and speed. Convenience is having all your programs and documents in one place. You don't need to search through your disk box for the right disks. In addition, a hard-disk drive transfers information considerably faster than a floppy disk can. In short, a hard-disk drive is a very large, very fast disk drive.

Your selection of hard-disk drives depends on which computer you have. The table on the next page shows the units that work with each type of computer. Some hard-disk drives work with every member of the Apple II family.

You can use the space on your hard-disk drive in different ways if the drive manufacturer allows you

PHOTOGRAPHY BY JOHN GREENLEIGH

Hard-Disk/Computer Compatibility

When choosing a hard-disk drive, look here first to see which brands you can connect to your Apple II. Then evaluate the drives based on their individual features described in the article.

COMPUTER	COMPATIBLE HARD-DISK DRIVES
Apple IIc with older ROMs (non-enhanced)	Quark QC-10, Quark QC-20
Apple IIc with newer ROMs (enhanced)	ProApp 10, ProApp 20, Quark QC-10, Quark QC-20
Apple II Plus, IIe, or IIGS	Quark QC-10, Quark QC-20, Sider D2, Sider D4
Apple IIe with Protocol Converter (UniDisk 3.5 controller card)	ProApp 10, ProApp 20
Apple IIGS	ProApp 10, ProApp 20
Apple II Plus, IIe, or IIGS with Apple SCSI card	Apple HD20SC, Apple HD40SC, HyperDrive FX/20, HyperDrive FX/40, ProApp 20S, ProApp 40S
Apple II Plus, IIe, or IIGS with CMS SCSI card	CMS SC20/AIIS, CMS SC40/AIIS, CMS SD20/AIIS, CMS SD40/AIIS

to partition the space. For example, you can use one portion for ProDOS programs while you use another for DOS 3.3 programs. Or you can use one portion of the disk for Apple II ProDOS programs and another for Mac programs. The table "Partitionable Drives" on page 36 lists the various hard-disk drives that you can partition and the types of partitions available.

The first step, then, is to select a drive manufacturer or two, based on what computer or computers you are using and whether you'll need to divide the disk among different operating systems. The next determination is how large a disk drive you should get.

Hard-disk drives come in different sizes, depending on the amount of data each holds, typically either 10, 20, or 40 megabytes. A megabyte is approximately one million bytes of information. A single text character typically takes up one byte of storage. Thus, a 10-megabyte hard-disk drive holds the equivalent of 73 5¼-inch floppy disks, or nearly 13 3.5-inch floppy disks.

Ten million characters may seem like a lot, but you can fill it up fairly quickly. If you are planning to partition the drive among different operating systems, you will generally need a larger disk than if you use it for only one system. In making your size determination, remember that the cost of an additional 10 megabytes on a single hard-disk drive is considerably less than the cost of a second 10-megabyte unit.

Operating Restrictions

Both ProDOS and DOS 3.3 place restrictions on the use of a hard-disk drive. The part of the hard-disk drive devoted to DOS 3.3 must be divided up into different volumes, each with a size of either 140 kilobytes (the standard size of a 5¼-inch DOS 3.3 floppy disk) or 400 kilobytes (the maximum size of a DOS 3.3 volume). This restriction is the main limitation DOS 3.3 imposes, but ProDOS imposes several limitations of its own.

A ProDOS volume currently is restricted to a size of 32 megabytes. Thus, under ProDOS, a 40-megabyte drive must be divided into two 20-megabyte volumes, or one 32-megabyte and one 8-megabyte volume. The other restriction of ProDOS is the number of files it permits in the root directory. You cannot place more than 51 files in this directory of a ProDOS disk. A subdirectory, which can be one of the files in the root directory, can contain as many files as you like, however.

With a 140K or 800K floppy disk, you'll rarely come up against this limit because you'll run out of disk space well before you create that many files. With a 10-megabyte or larger volume, though, you may easily have more than 51 files on the disk. The solution is to arrange the files carefully, using logically designed subdirectories, so that no more than 51 files are in the root directory.

Certain ProDOS programs also place a restriction on the number of files in a subdirectory the program can recognize in its disk operations. If you notice that a filename does not appear, even though you know it is on the drive, you probably have a program with this problem.

Copy-Protection

Copy-protection is another consideration in hard-disk drive organization. You cannot put a copy-protected program onto your hard-disk drive, with three exceptions:

1. You can use some copy-protected programs on a hard-disk drive with a special program. The best known of these programs is Catalyst from Quark. Catalyst works only with programs that follow the Catalyst copy-protection standards.
2. You can install some copy-protected programs, such as Sensible Speller, on your hard-disk drive even though you cannot copy the program onto another floppy.
3. You can copy some copy-protected programs to your hard-disk drive. When you start that particular program, it requests that you place the original disk in one of your floppy drives.

Finally, you should give some consideration to how you will select from the programs on your hard-disk drive. Selecting programs from a menu is usually

Partionable Drives

Some hard-disk-drive makers let you divide up the disk space into partitions. This chart shows which drives accommodate partitioning.

DRIVES	TYPE OF PARTITION
Apple HD20SC and HD40SC	None
CMS SC20, SC40, SD20, and SD40	Different ProDOS volumes that can be used by one or multiple Apple II computer(s) equipped with CMS SCSI cards. Can be shared between an Apple II and a Macintosh.
HyperDrive FX/20 and FX/40	None
ProApp 10, 20, 20S, and 40S	Can be shared between an Apple II and a Macintosh. The Apple II portion can split between the DOS 3.3, UCSD p-System, and ProDOS operating systems.
Quark QC-10 and QC-20	Can be shared between an Apple II and a Macintosh computer. The disk can be divided into multiple volumes of varying sizes for use by either the Macintosh or Apple II.
Sider D2, D4, and C46	The disk can be divided into multiple DOS 3.3 areas (either 140K or 400K in size), four CP/M volumes, four UCSD p-System volumes, and two ProDOS volumes.

simpler than remembering the full program pathname and issuing a Run command. You can use a program-selector program, such as ProSel, RunRun, Catalyst, or DeskTop (on the IIGS). These programs usually return you to the menu after you've run a program.

Let's take a look at the six major brands of hard-disk drives for the Apple II family. There is a great deal of similarity between drives of different sizes from the same manufacturer, so I reviewed one drive only from each vendor. I'll discuss what sorts of drives each vendor makes and describe the size and noise level—factors to consider when selecting a drive. I'll also list what type of indicator lights each drive has, an important feature for many people. Indicator lights can tell you if the system is hung up or let you know that everything is proceeding smoothly.

Apple

Apple makes two SCSI hard-disk drives (see "SCSI Drives," which accompanies this article, for an explanation of the term *SCSI*) that work with the Apple II Plus, IIe, or IIGS with an Apple SCSI interface card. The units are the 20-megabyte HD20SC and the 40-megabyte HD40SC. The drives are identical except for their disk capacity. I tested the HD20SC with an Apple SCSI card.

The HD20SC is one of the larger units tested in terms of the amount of desktop space it requires. It measures 10 inches wide by 10½ inch deep and 3 inches tall. It is about midrange among the units in terms of fan noise, and it also makes a chirping sound whenever the drive head moves from one track to another. A red light on the front panel indicates drive activity.

You can place the Apple SCSI card in any slot of an Apple IIe or IIGS if you are going to connect one or two drives to it. If you are going to connect three or four drives, you must install the card in slot 5. On the Apple IIGS, doing so prevents use of the built-in Smartport for connecting 3.5-inch drives.

Each drive in any SCSI system, and the SCSI card itself, must have a unique "priority" number (see "SCSI Drives"). You set the priority of the Apple HD20SC by pushing a wire into a small hole in the back of the drive, and you change the SCSI-card priority by means of a jumper on the card itself.

This drive doesn't have any unique features, but if the Apple label is important to you, it might be worth the extra price you pay.

CMS

The CMS family of SCSI hard-disk drives requires a CMS SCSI-interface card. The Apple SCSI card does not work with them. You have to follow the documentation closely to properly configure the card, unless it comes preconfigured. The price you pay for the versatility of the CMS SCSI card is its configuration complexity. You can connect two CMS drives or two partitions on the same CMS drive to each SCSI card. I tested the 40-megabyte CMS S40.

One distinguishing feature CMS provides is the ability to configure the SCSI card to permit read-only access to a drive or partition. Your computer can then read a file from the hard-disk drive but not modify or delete the file. Read-only capability is useful when two or more computers are sharing files on one hard-disk drive.

The read-only capability can be troublesome, though. If you start AppleWorks from a read-only volume, for instance, you will find yourself in an endless loop. AppleWorks will request that you remove the write-protection from the volume on which it is located, something you cannot do.

Besides the CMS S40, the company also sells a 20-megabyte unit. Although CMS makes higher-capacity units, they are not very prac-

tical for an Apple II, in view of ProDOS's volume-size restriction.

The CMS drive is the quietest of all the hard-disk drives I tested. You hear just the noise of a fairly quiet fan. It has two lights on its front panel: A green light shows that the unit's power is on, and an amber light indicates that disk access is occurring. The unit is box-shaped (10 × 6 × 5.5 inches), with a retractable carrying handle—the editors at *A+* call it the CMS lunchbox. CMS also sells a stack-shaped unit that you can stack above or below other components.

HyperDrive FX

General Computer manufactures the HyperDrive FX in 20- and 40-megabyte configurations. The company is known in the Macintosh world for having created the first fast internal hard-disk drive for the Macintosh. General Computer also has an external SCSI hard-disk drive, the HyperDrive FX, that works with the Apple II Plus, IIe, IIGS, and Macintosh.

The HyperDrive FX/20 is a 20-megabyte unit resembling a fairly thick book placed upright on its spine. The unit is 8 inches high, 13 inches long, and 4 inches wide, with a handle built into its top. The HyperDrive FX is somewhat noisier than the CMS drive, but the only noise comes from the fan. It has a single red light on its front panel that indicates when disk access is occurring.

You must use the Apple SCSI card with the HyperDrive FX. To install the hard-disk drive, you place the SCSI card in your computer, connect a SCSI-system cable between the card and one port on the HyperDrive, and place a SCSI terminator on the other port on the back of the HyperDrive. If you are going to use more than one HyperDrive (or the HyperDrive and another SCSI unit) at the same time, you will also have to check the SCSI identification number of each unit. The HyperDrive comes with a utility program that permits you to check and change this value.

General Computer includes Apple's Backup II program (see "Hard-Disk File-Maintenance," which accompanies this article) with the HyperDrive FX, as well as a hard-disk-drive manager program called FX Manager. FX Manager lists all devices on the SCSI bus, tests or initializes the hard-disk drive, and checks or changes SCSI identification numbers.

ProApp

The ProApp hard-disk drive is a versatile drive, working with the Apple IIc, IIe, and IIGS as well as the Macintosh. It is a non-SCSI unit that comes in 10- and 20-megabyte sizes. ProApp also makes a SCSI 20-megabyte model. The non-SCSI unit is 3 inches tall, 6½ inches wide, and 10 inches deep. At this writing, ProApp units came with an external power supply, but new models under development have a built-in supply. I tested a 20-megabyte unit with an external power supply, which lowers the heat in the drive unit itself. The power supply fits nicely on the floor, much like the IIc power supply.

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The fan noise of a ProApp is about midway between that of the CMS drive and the HyperDrive FX. The drive also makes a fairly quiet chirping sound whenever disk access occurs. There are three lights on the front panel. A green light, labeled ready, blinks when the unit is first powered on and remains on when the unit reaches its ready state. A red light, labeled disk, shows when disk access is occurring. The third light is labeled busy. If any of the lights blink after the drive has reached the ready state, something is wrong with the drive.

The standard ProApp connects to an Apple II Plus, IIe, or IIGS equipped with either a UniDisk 3.5 drive controller card (Protocol Converter), or to the disk port on an enhanced Apple IIc or IIGS. If you connect the drive in a chain, it must be the last drive in the chain. The SCSI model uses an Apple SCSI card.

The ProApp unit can handle three different Apple II operating systems: DOS 3.3, ProDOS, and the UCSD p-System (Apple version 1.3). You can also have a coresident Macintosh partition. Utilities and the three operating systems come with the drive. The version of DOS 3.3 that comes with the ProApp, called RigiDOS, is a modified DOS and is not guaranteed to be compatible with all DOS 3.3 programs. I was unable to find any major program that did not work with the unit. The Chooser utility permits you to specify which operating system will be active when you start your ProApp and also allows you to switch between operating systems.

The ProApp Company has been acquired by an IBM hard-disk-drive manufacturer named Logic Array, which is continuing to manufacture the drives under the ProApp label.

Quark QC

The Quark QC works with the Apple IIe, IIc, and Macintosh and can handle both the ProDOS and UCSD p-System operating systems. You can partition the drive into as many as 63 different volumes, with up to four different volumes active at one time. Each volume on the QC drive has a specified size, name, and operating system and certain access restrictions. The three access levels are public, group, and private. You specify for each access level whether access is permitted and, if so, whether access is read only or read, write, and delete.

The QC-20 drive I evaluated contained 20 megabytes of storage and had the largest physical dimensions of any of the drives I tested. (The QC-10, which is the same physical size, contains 10 megabytes of storage.) The drive is 14 inches wide, 9 inches deep, and 4 inches high. The top of the unit has no ventilation slots, so you can easily put the QC on top of your computer and put your monitor on top of the drive. The Quark QC's noise level is about the same as that of the ProApp. The drive has a single red light on its front panel that shows when disk access is taking place.

Installation of the Quark QC varies with the computer setup. The steps are not difficult, and the

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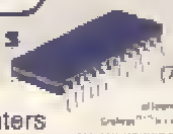

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drive comes with all the converter cables you'll need. This drive is the only one I tested that works with whatever form of floppy-disk interface you have on your computer, even with the old Disk II interface card. The Quark drive does not boot automatically; i.e., you cannot turn on your hard-disk drive and your computer and have the system start from the hard-disk-drive driver on it. All the other drives reviewed permit automatic booting.

I could not get the Quark to work with the Apple IIGS through the Smartport connector, although it does work with the IIGS with a Disk II controller.

Quark Peripherals is no longer manufacturing Quark QC drives, although Sun Remarketing is distributing them. I included this drive in this article because it works with any Apple IIc (enhanced or not) and with any Apple IIe, even without a Protocol Converter card.

Sider

The Sider is manufactured by First Class Peripherals, a division of Xebec. It resembles a book placed upright on its spine and measures 7 inches high by 16 inches deep by 3½ inches wide. The drive is slightly noisier than the ProApp. It has a single red light on its front panel that shows drive access.

The Sider connects to an Apple II Plus, IIe, or IIGS through its own interface card, which comes with the hard-disk drive. You can place the card in any available slot, although, for automatic booting, you should put it into slot 7. Physical installation requires 20–30 minutes and is a bit more difficult than installation of the other hard-disk drives in this article.

The Sider can handle more Apple II operating systems than any other hard-disk drive can—ProDOS; UCSD p-System; DOS 3.3; and several versions of CP/M (Microsoft Softcard, Applied Engineering CP/AM; and PCPI Versions 1.5, 1.6, and 2.0). First Class Peripherals supplies utilities for each of the operating systems, but you must supply the actual operating-system software (and the interface card in the case of CP/M).

The need for backups with a hard-disk drive is critical: Although a hard-disk drive rarely fails, the consequences of a failure are great.

The Sider documentation provides the greatest amount of technical information and describes how to customize the start-up operation within each of the four different operating systems. A menu-style program selector for the ProDOS portion of the drive comes with the system software.

The B-Sider, a tape backup unit, provides high-speed file, volume, and drive-image backups of your drive. First Class Peripherals supplies a backup program that works with the B-Sider and with other backup media such as 3.5- and 5¼-inch floppy disks. The program does not provide incremental backup capability.

Which Drive for You?

The compatibility list accompanying this article names the hard-disk drives that work with each member of the Apple II family. Note that each manufacturer offers several different drives. Once you decide that you need (or at least want and can afford) a hard-disk drive, you should determine from the list and tables with this article (through page 49) the drives that can work with your setup. Next you should check which ones can handle the operating systems you want to place on your drive. Then look back at the descriptions in this article of the individual products. Your final decision then becomes a matter of drive capacity.

Happy driving. +

Michael Fischer works in the field of court administration in California and writes about Apple computers. His latest book is Apple IIGS Technical Reference, *from Osborne/McGraw-Hill.*

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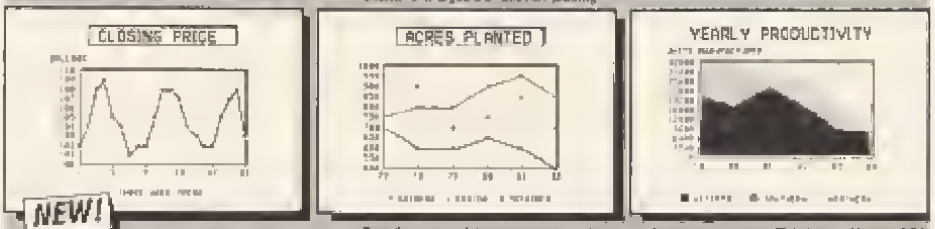

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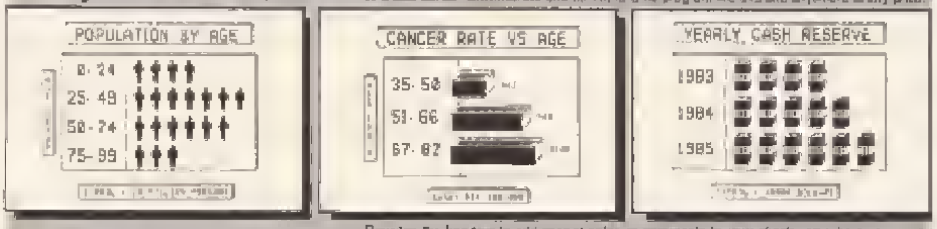

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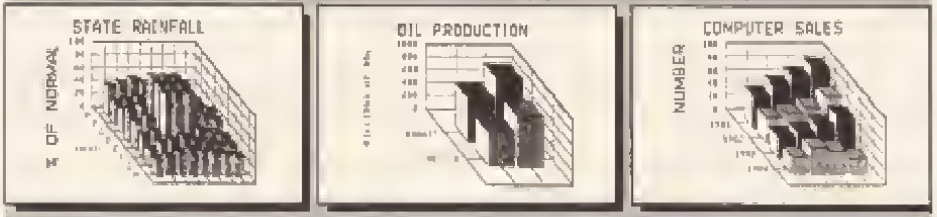

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Hard-Disk File-Maintenance

If you are going to get the most value from your hard-disk drive, you will have to adopt some relatively methodical, although easy-to-perform, file-maintenance habits. Let's examine these procedures.

Backups

Nearly any computer-program manual or book for novices discusses (or preaches about) disk backup. If you follow recommended procedures, you usually make a backup of every program disk and data disk that contains information you want to keep. Believe it or not, I actually know some people who do so. But many of us, myself included, get lazy and don't take the time to make regular backups, particularly of our data on floppy disks. If a disk is damaged or lost, at least we haven't lost too much data.

The need for backups with a hard-disk drive, though, is much more critical. My hard-disk drive contains not only the programs that I commonly use, but also all the data I've created with the programs. If the hard-disk drive should become unreadable, I would lose *every* important document I had, not just the several documents that might reside on a floppy disk. The bottom line is: Although a hard-disk drive rarely fails, the consequences of a failure are great.

It normally takes less than five minutes to make a backup copy of a floppy disk. It can take considerably longer to perform a backup of a hard-disk drive, however.

There are four different methods with which you can make a backup of your hard-disk drive. You can use the 5¼-inch drive that most of us have on our Apples. Bear in mind, though, that the disks that work in the 5¼-inch drive hold only 140 kilobytes of information. You will need to have many disks and swap them often, if you use 5¼-inch floppy disks for backup.

The UniDisk 3.5 and Apple 3.5 Drives use diskettes that contain 800K of information. Obviously you need far fewer 3.5-inch disks than 5¼-inch disks to do the same amount of backup, but you will usually require multiple disks and disk swapping even when you're using the 3.5-inch drive.

Tape Backup

A tape backup unit provides you with the ultimate in backup ease. It lets you copy the contents of your hard-disk drive, or any particular files that need backup, onto a tape cassette. A tape unit is fast, and each cassette holds more than the contents of a hard-disk drive. But a tape unit is expensive, often costing as much as the hard-disk drive. It also takes up desk space.

Some people purchase two hard-disk drives, using the second one to hold a backup copy of the first unit. You also have a second hard-disk drive available if anything should happen to the first unit. The second unit holds only the same amount of data as the first unit, though, preventing you from making several backups, as you can with a removable tape unit.

You can use a tape backup or second hard-disk drive only if your system permits you to connect more than one drive. The table below shows whether a particular setup permits a second unit and whether a tape unit is available.

When making a backup, you can use any program that permits copying of files. FID, which comes with the DOS 3.3 System Master, performs this function in the DOS 3.3 operating system. If you are using Pascal, you use the Filer. In ProDOS, you have several backup options. You can use the ProDOS Filer that comes with the Apple IIe or the System Utilities that come with the Apple IIc and Apple IIGS. You can also use other ProDOS file-management programs such as DeskTop (on the IIGS), Catalyst, or CatDoctor (part of the ProSel package). Each of these programs requires you to select files to be copied and can copy only as many files at once as will fit on a single backup disk.

A more useful program, available only for ProDOS files, is Backup II from Apple Computer. This program allows you to copy either the entire hard-disk drive, selected subdirectories on the hard-disk drive, or every file on the hard-disk drive that was modified since the last backup. This last type of backup is called an incremental backup and is the fastest

This table shows what other devices you can add to your system, depending on what kind of Apple II you have and what kind of hard-disk drive you have attached to it.

COMPUTER	HARD DISK	TAPE	2ND DRIVE
Apple IIc	Any	No	No
Apple II Plus, IIe, or IIGS	Quark	No	Yes*
Apple II Plus, IIe, or IIGS	Sider	Yes	Yes
Apple IIe with a Protocol Converter (UniDisk 3.5-inch controller card) or IIGS	ProApp	No	Yes*
Apple IIe or IIGS with SCSI card	Any	Yes	Yes

* A second unit requires another disk controller or Protocol Converter card.

way of ensuring that you always have an up-to-date backup of files on your disk. Backup II automatically prompts you for additional floppy disks when the current one is filled.

Archiving and Deleting

Even though a hard-disk drive has lots of space, you will want to transfer files that you are no longer using from the hard-disk drive to make room for more-current files. You can check the date of the file's last use (if you are in ProDOS or the UCSD p-System) to determine if the file is a likely candidate for archiving. At the same time you're archiving files, you should check if your hard-disk drive contains files that you no longer need at all.

Reorganizing

Besides organizing and archiving files for your convenience, you should also consider how the drive itself electronically organizes the files. Each time you modify a file on your hard-disk drive, you run the risk of fragmenting the file. ProDOS normally attempts to save a disk file in one location on the drive. If it doesn't find sufficient room, it places different parts of the file in different locations. When you increase the size of a file, it will no longer fit in its original location on the disk, so ProDOS must split it up. A file that is split into several parts takes longer to access than a similar-size file in one piece.

A software program called a disk reorganizer takes every file on a disk and places it in a location where it can all fit in one piece, taking all the small pieces of empty disk space and combining them into one big space. You should make a full backup of your hard disk before you use this program. If the program is interrupted, the files on your disk can become hopelessly scrambled. Beachcomber (part of the ProSel package) is one such disk reorganizer.

If you do not have a disk reorganizer, you can perform the same process, albeit in a more tedious and time-consuming manner, by copying every file from your hard-disk drive to a floppy disk, erasing all the files, and then recopying the files back. This process is especially tedious if you have many subdirectories on the hard-disk drive.

Michael Fischer

SCSI Drives

If you hear a friend say she has a "scuzzy disk drive," she doesn't mean it's time to send that drive to the cleaners. *Scuzzy* is merely the way to pronounce the initials SCSI (Small Computer Systems Interface), which denote a standard way of connecting devices to a microcomputer. This method involves a cable of 50 wires, each of which contains a specified signal, which connects a SCSI peripheral device to a SCSI port on a computer. On an Apple II Plus, IIe, or IIGS, you install the SCSI port by means of an interface card you place in any slot except slot 3.

The SCSI interface is a parallel interface. All eight bits of data that comprise a single character travel over the cable at once, on eight separate wires. By contrast, the bits in a serial interface travel one at a time on a single wire. Assuming the signals all travel at the same speed, it takes a serial interface eight times as long as a parallel interface to transmit a character.

The SCSI standard did not just come from nowhere. Its predecessor was SASI, which stands for Shugart Associates Standard Interface. Shugart Associates, a hard-disk-drive manufacturer, developed SASI in the late 70s. This standard is used in the Sider hard-disk drive.

The American National Standards Institute (ANSI) modified SASI to add extra features and then issued it as standard X3T9.2, called SCSI. Unfortunately, nothing remains standard once it gets out into the real world. Apple has modified SCSI in two respects:

1. Its connector has only 25 signals or wires, not the full 50 signals (25 of which are ground) that are part of the SCSI standard.
2. It provides a different method for implementing termination resistors (discussed below).

The differences between Apple SCSI and standard SCSI account for the incompatibility between the CMS SCSI drives and cards and the other SCSI drives and cards that follow the Apple II modifications.

Seven Up

When you set up a SCSI port on your computer, you can add up to seven devices (the SCSI card itself being one device), subject to certain restrictions. Each device must have a separate priority number (from 0 to 7). The port on the computer itself must also have a priority number different from those of all devices on the line. The Apple II SCSI card is set up to be device number 7 unless you modify it. The method of changing device numbers varies with the peripheral device. Some, like the Apple HD20SC, have a rotating wheel that displays the device number. Others, like the CMS 40S, use a row of tiny switches, called DIP switches, to set the number. And some, like the HyperDrive FX/20, require the use of a software program to change the number.

The priority number in SCSI is more than just a number. The higher the value, the more attention the SCSI controller pays to the unit. Thus, SCSI unit 7 gets top priority when more than one unit is seeking to use the SCSI line, whereas SCSI unit 0 can use the line only when all other units are idle.

On the Apple II Plus, IIe, and IIGS, the ProDOS operating system restricts the number of SCSI hard-disk drives that you can connect to any SCSI card. Any card in slots 1, 2, 4, 6, or 7 can have two SCSI drives attached to it. A card in slot 5 can have four drives, as long as slot 2 does not contain any drives.

The Terminator

The 25 to 50 wires in the SCSI line each contain an electrical signal. You must observe several restrictions to prevent loss of signal strength or interference of one part of the signal with another. You are limited to 20 feet of cables among all the units, and one or two terminators must be attached to the line. The effect of the terminator is to reduce noise, or signal interference. One terminator is necessary if your SCSI system is restricted to one SCSI device other than your computer and the total cable length is less than 10 feet. Otherwise, two terminators are required. Terminators are small and relatively cheap ($30 list for the Apple terminator) and do not count as a SCSI device.

Michael Fischer

Apple II Hard-Disk Comparison Chart

HARD DISKS	SIZE (MB)	PRICE	IIc	II Plus or IIe	IIGS	Mac	SCSI	Pro-DOS	DOS 3.3	Pas-cal	CP/M	WARRANTY
APPLE COMPUTER, INC.												
HD20SC	20	$1508		■	■	■	■	■				90 days; extendable[3]
HD40SC	40	$1999		■	■	■	■	■				
CMS[1]												
SC20/AIIS	20	$895		■	■	■	■	■				1 year
SC40/AIIS	40	$1595		■	■	■	■	■				
SD20/AIIS	20	$895		■	■	■	■	■				
SD40/AIIS	40	$1595		■	■	■	■	■				
GENERAL COMPUTER CORPORATION												
HyperDrive FX/20	20	$1229		■	■	■	■	■				1 year; extendable[4]
HyperDrive FX/40	40	$1829		■	■	■	■	■				
LOGIC ARRAY												
ProApp 10	10	$715	■	■	■	■		■	■	■		1 year
ProApp 20	20	$897	■	■	■	■		■	■	■		
ProApp 20S	20	$715		■	■	■	■	■				
ProApp 40S	40	$1235		■	■	■	■	■				
SUN REMARKETING												
QC-10	10	$795	■	■	■	■		■	■			90 days
QC-20	20	$895	■	■	■	■		■	■			
FIRST CLASS PERIPHERALS												
Sider D2	20	$695		■	■			■	■	■	■	Variable; check with your dealer
Sider D4	40	$995		■	■			■	■	■	■	
Sider C46[2]	40	$1795		■	■			■	■	■	■	

[1] The CMS SC drives come in a cube shape; the SD drives are rectangular.
[2] Comes with 60-megabyte tape backup unit.
[3] Up to 3 years with AppleCare
[4] 3 years with HyperCare

Souping Up Your Sider

The most popular Apple II hard-disk drive for the past several years has been the Sider from First Class Peripherals. It's beginning to show its age, however, since it's not quite as fast as the newer SCSI-type drives, and it still insists on booting up under DOS 3.3, even though ProDOS is clearly the operating system of choice for high-capacity drives.

Happily, Advanced Tech Services has developed the perfect rejuvenation pill for the Sider: a Host Adapter Firmware ROM that configures the Sider (10 megabytes) or Sider II (20 megabytes—now called the Sider D2) as a single ProDOS volume. It also increases the effective data-transfer rate between drive and computer by 20–25%, making the Sider somewhat faster than SCSI drives. The data-transfer rate is highest when you're using a GS or an accelerated II Plus or IIe.

Another important feature of the ROM is its ability to recognize and work with a second Sider daisy-chained to the first. In addition, the formatting program that comes with the ROM checks for bad blocks while formatting the Sider and assigns any it finds to a dummy file so they won't interfere with your own files.

Special versions of the ROM are also available for the new 40-megabyte Sider and the old Xebec Trustor 30. (The standard ROM works with the Trustor 10.)

The price of any version of the ROM is $49.95. You can reach Advanced Tech Services at P.O. Box 920413, Norcross, GA, 30092; (404) 441-3322.

Gary Little

Parking Your Drive

When I got my hard-disk drive, one of the items on the Utilities menu referred to "parking" the drive's heads. I didn't know what that meant, but, ever adventurous, I tried it out. The drive whirred and clicked a little, and then a message appeared on my screen saying I could now safely power down the drive. Naturally, I proceeded to run this utility each time I used the drive.

Here's what "parking heads" is all about. Inside a hard-disk drive you'll find one or more spinning, rigid disks, containing the information stored in the drive, and one or more heads, electromagnetic devices that read information stored on the disks and write it to the

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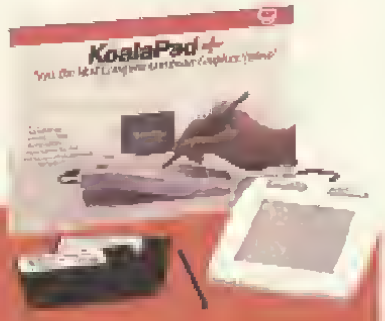

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disks. The disks spin rapidly, and the heads ride a fraction of an inch above the disks. If the heads actually touch a disk, particularly when it is spinning, the information on the disk can be damaged or destroyed.

Every time you physically move your hard-disk drive, you run the risk of having a head crash into a disk, damaging it and wiping out your precious data. In addition, your drive is in danger every time you turn it on. Nearly all drive power failures occur at power-up—when you turn on your drive, a power surge can damage the data under the drive's heads.

On the outside of any disk inside a hard-disk drive is an area that the drive doesn't use to store data. When you park your drive's heads, you cause the stepping motor inside the drive to move the heads so that they are located above this unused area of the disk. If the disk head nicks the disk at this location or if power surges through the drive head while it is over this portion of the disk, your data is likely to remain safe.

Michael Fischer

Products and Manufac

Apple Computer, Inc.
20525 Mariani Avenue
Cupertino, CA 95014
(408) 996-1010

HD20SC 20-megabyte SCSI hard-disk drive with SCSI card, SCSI System Cable, and SCSI Cable Terminator—$1508

HD40SC 40-megabyte SCSI hard-disk drive with SCSI card, SCSI System Cable, and SCSI Cable Terminator—$1999

Apple II SCSI Card with SCSI System Cable and SCSI Cable Terminator—$209

Apple SCSI System Cable (for connecting first SCSI peripheral to SCSI card)—$50

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Apple SCSI Cable Extender (for extending SCSI cable)—$40

Apple SCSI Cable Terminator—$30

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(714) 549-9111

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ProApp 20S 20-megabyte SCSI hard-disk drive—$715

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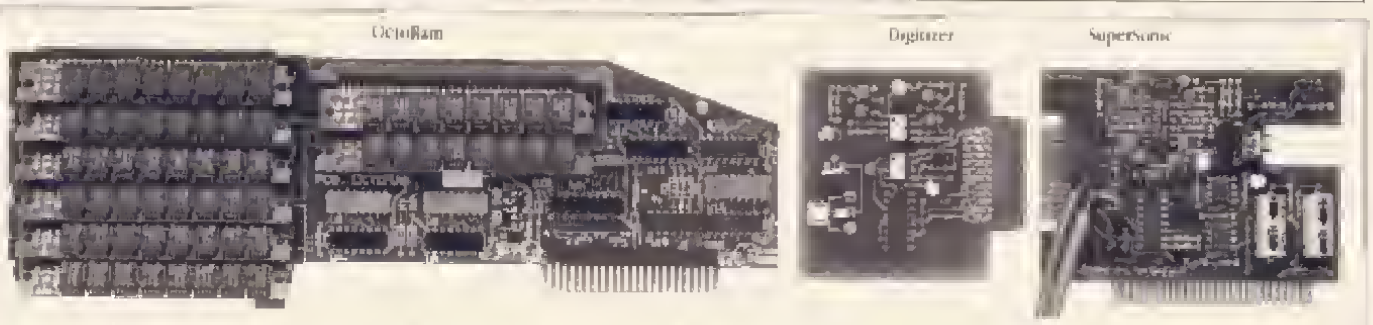
Sider C46 40-megabyte hard-disk drive with 60-megabyte tape backup in one unit—$1795

Anyone Else?

The hard-disk drives this cover story describes in detail aren't the only ones available for the Apple II. They were the only ones we were able to obtain for this article, however. Peak Systems of Austin, Texas ([512] 329-1020); Sunol Systems of Pleasanton, California ([415] 484-3322); and Infax, Inc., of Decatur, Georgia ([404] 981-4520) for instance, each have Apple II hard-disk drives but weren't able to send us evaluation units early enough for inclusion in this article. Chinook Technology of Longmont, Colorado ([303] 449-1207) had a 20-megabyte drive under development at this writing, which the company said might be available by the time you read this story. Other vendors—including Corvus Systems and AST Research—that might seem to be notable exclusions didn't appear because they are no longer actively seeking Apple II customers for their hard-disk drives and asked to not be covered in this story.

Lisa Raleigh



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